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The Relative Contributions Of Parental And Sibling Substance Use To Adolescent Tobacco, Alcohol, And Other Drug Use

Abigail A Fagan, Jake M Najman.[1]

ABSTRACT

While research demonstrates that parental tobacco and alcohol use increases the likelihood of children's substance use, it is unclear whether or not sibling use has a greater, weaker, or similar effect. Based upon self-reported information from Australian adolescents, their siblings and parents, this investigation examines the association between siblings' tobacco and alcohol use. The relationship is consistent, moderately strong, and remains significant when controlling for a number of family-related factors, indicating that the shared environment cannot fully explain the extent of similarity in siblings' behaviors. In addition, sibling substance use has a greater effect on adolescent substance use than does smoking or drinking by parents. These findings indicate the need to include siblings and information regarding sibling relationships in prevention and intervention programs.

INTRODUCTION

Parental use of tobacco, alcohol, and other drugs increases the likelihood that children will also engage in substance use (DeWitt, Silverman, Goodstadt, & Stoduto, 1995; Epstein, Williams, Botvin, 2002; Hawkins, Catalano, & Miller, 1992; McGue, Sharma, Benson, 1996; Unger & Chen, 1999). While a genetic transmission of a propensity to use drugs, particularly alcohol, has been noted (McGue et al.), parental use is typically understood to lead to children's use through social learning processes. Parents who espouse norms favorable to substance use, and who model such behavior, encourage imitation by children and reinforce attitudes and behaviors that promote tobacco and alcohol use. In fact, children who believe that drug use is normative may be less likely to view illicit substances as harmful, more likely to perceive social reinforcement for such behavior, and more likely to smoke or drink themselves (Botvin, Baker, Dusenbury, Tortu, & Botvin, 1990; Unger & Chen).

Although parental use is a strong risk factor for children's use, illicit drug use by peers may be even more influential. Social learning theory posits that imitation of deviant behavior is most likely to occur when models are very salient, and during adolescence, peers likely eclipse parents as the most important role models in children's lives. Association with drug-using peers has been identified as a primary risk factor for adolescent substance use (Elliott, Huizinga, & Menard, 1989; Hawkins et al, 1992; Huizinga, Loeber, & Thornberry, 1994). Moreover, studies that include

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[1] Abigail A. Pagan, Ph.D., is currently with the Social Development Research Group at the University of Washington. Her current research involves working with communities using the Communities that Care program to assess youth risk and protective factors and implement prevention programs that help prevent substance use and delinquency. Jake M. Najman, Ph.D., has a joint appointment as Director of the Queensland Alcohol and Drug Research and Education Centre, School of Population Health and Professor of Sociology in the School of Social Science, University of Queensland.

both sources of influence generally find that peer use is a stronger predictor of adolescent substance use than is use by parents (Brook, Whiteman, Gordon, & Brook, 1990; DeWitt et al., 1995; Unger & Chen, 1999).

SUBSTANCE USE BY SIBLINGS

Given that parents and peers who engage in tobacco and alcohol use may increase adolescent use, it is surprising that substance use by siblings has received comparatively little attention. Studies of familial influences on adolescent substance use sometimes include separate measures of sibling use in their analyses, but sibling influences are typically not assessed in much detail. Likewise, investigations of the effects of peer substance use rarely examine whether or not respondents have siblings who smoke or drink.

Though often overlooked in the literature, siblings may act as powerful role models for one another, particularly given that their influence extends from the family to the peer domain. As members of the same family, siblings have a long history of shared experiences and strong ties to one another that are not easy to escape (Boyle, Sanford, Szatmari, Merikangas, & Offord, 2001). Like peers, siblings are close in age and generally spend much time together. Teenagers may also turn to their siblings, as they do their other friends, to obtain illegal substances (Boyle et al.; Brook et al., 1990; McGue et al., 1996). Brook and colleagues highlighted the importance of "drug advocacy" by siblings, who may encourage and approve the use of illegal substances, as well as actually supply them to their brothers or sisters. Likewise, Rowe and Gulley (1992) have speculated that when siblings have a close relationship, they will be more likely to imitate one another and even commit deviant acts, such as drug use, together.

Investigations that have examined sibling tobacco and alcohol use generally find that siblings' rates of use are very similar, and that use by one sibling is significantly related to use by the other (Brook et al., 1990; McGue et al, 1996; Miller & Volk, 2002). Several studies report moderately strong correlations for sibling substance use (Boyle et al., 2001; Brook et al.; DeWitt et al, 1995; Durrington, Fagan, & Chant, 2003; McGue et al.). Substance use by siblings has been demonstrated in multivariate analyses to increase the odds of adolescent smoking, drinking, or other drug use (Boyle et al.; Durrington et al.; Epstein et al., 2002; Miller & Volk; O'Connell, Alexander, & Dobson, 1981; Rowe & Gulley, 1992; Unger & Chen, 1999). In accordance with social learning theory, several investigations report the strongest relationships for siblings who are close in age and of the same sex (Boyle et al.; McGue et al.).

Investigations that compare sibling and parent influences upon substance use generally find a stronger association between siblings than for parents and children (Boyle et al., 2001; Brook et al., 1990; DeWitt et al., 1995; Epstein et al., 2002; Unger & Chen, 1999). For example, Boyle and colleagues found that tobacco, alcohol, and drug use by siblings increased the odds of similar behavior for respondents, but there was no relationship between parental and respondent use. According to the few studies that simultaneously assess the independent effects of parental and sibling tobacco or alcohol use, use by both types of family members generally predicts

adolescent use, but the relationship tends to be stronger for siblings than for parents (Brook et al.; Epstein et al.; Unger & Chen, 1999).

Although these investigations all highlight the potential for sibling substance use to increase the likelihood of adolescent tobacco and alcohol use, perhaps more so than parental use, the investigations have several limitations. The majority of studies rely on respondents to report their siblings' levels of substance use, rather than elicit information from siblings themselves. In addition, most investigations have not considered whether or not similarity in sibling smoking and drinking can be attributed to the sibling relationship itself, or to shared characteristics of the family environment, which may act upon both siblings to produce similar behavior. For example, family conflict may increase the likelihood of alcohol use, and if all children in the family are exposed to such negative events, they will all be at increased risk for drinking. Investigations must therefore include family risk factors for substance use in the analyses to control for such processes, but very few studies have done so (but see Durrington et al., 2003).

There has also been limited research regarding the relative contributions that parents and siblings may make towards adolescent tobacco and alcohol use. The few studies that include information regarding use by both types of family members tend to test effects separately, precluding a direct comparison of the size of the contributions. Likewise, investigations generally rely on respondent reports of parental (as well as sibling) use, rather than generate information from parents directly.

The current investigation addresses these issues by examining sibling similarity in tobacco and alcohol use and assessing the extent to which such resemblance can be attributed to both siblings experiencing a similar family environment. In addition, analyses explore whether or not siblings have stronger, weaker, or similar effects on adolescent tobacco and alcohol use compared to parents.

RESEARCH METHOD

THE SAMPLE

The study relies on data from the Mater-University Study of Pregnancy (MUSP), an Australian longitudinal investigation of women's and children's health and development. Pregnant women attending their first prenatal visit (on average, at 18 weeks gestation) at a hospital in Brisbane, Australia were recruited into the study from 1981 to 1983. Of the 8,556 women invited to participate in the study, 8,458 (99%) completed prenatal interviews and 7,661 gave birth to a live, single child and completed postnatal interviews. Additional interviews were conducted when children were six months, five years, and 14 years old (see Keeping et al., 1989, for further detail regarding the project design.)

Because sample selection occurred over three years, some women returned to the hospital to give birth to a second child (herein referred to as the "younger sibling"), which resulted in a subsample of 685 sibling pairs. These 1,370 children, aged one to three years apart, are the focus of the current study. The demographic characteristics

of the sibling sample are very similar to the full sample. At entry to the study, mothers were 13 to 40 years old (mean = 24 years). The majority (65%) had completed high school, 20% had not, and 14% had tertiary education. Almost all (92%) women were married or living in de facto relationships at the time of birth, and 90% were Caucasian. Approximately one third of the sample was classified as low income, earning less than $10,400 AUD per year or $200 per week.

SAMPLE ATTRITION

At the 14-year follow-up assessment of mothers and children, 376 sibling pairs (55%) remained in the study, including 93 sister pairs, 97 brother pairs, and 186 mixed-sex sibling pairs. The attrition rate for the sibling sample is greater than that of the larger sample (69%), given that if a mother or sibling withdrew from the study, the other sibling was also likely to withdraw. Attrition analyses conducted for the full sample demonstrated that mothers lost at the five-year follow-up were significantly more likely than those remaining to be teenagers at the time of their children's birth, have lower levels of education, and live in poverty when children were 0 to 5 years. This differential attrition is also likely to be more pronounced in the sibling subsample, and maternal age, education, and family income are included in subsequent analyses.

DEPENDENT VARIABLES

Adolescent tobacco and alcohol use is based on self-reported information obtained from each sibling at the 14-year follow-up assessment, conducted from 1995 to 1997. In order to ensure that data were collected at the same developmental period for all respondents, assessments occurred in roughly the same order in which children were born. Thus, older siblings' interviews preceded younger siblings' by one to three years, but all respondents averaged 14 years of age at the time of the interview. (The mean age of older siblings was 14.0, compared to 13.7 for younger siblings.)

Adolescent tobacco use was assessed by asking each sibling to report the number of cigarettes they had smoked in the past week. Six frequency choices were given, ranging from smoking no cigarettes to smoking 50+ per day. The variable was then dichotomized, comparing nonsmokers (those reporting smoking no cigarettes) and smokers (all others). Adolescent alcohol use was measured with the question: "How often do you drink alcohol?" The original six-point frequency scale was collapsed to differentiate nondrinkers (those reporting never drinking) and drinkers (those reporting rare to daily use of alcohol).

INDEPENDENT VARIABLES

Information regarding parental tobacco use and maternal alcohol use was obtained at the 14-year follow-up assessment conducted with mothers. Maternal smoking was based upon the same question given to children: "In the last week, how many cigarettes did you usually smoke per day?" The six response choices were then dichotomized, comparing nonsmokers (those reporting no cigarette use) to smokers (those reporting one to 50+ cigarettes per day). Paternal smoking was reported by mothers, based on the question: "Does your partner smoke?" The constructed dichotomous variable compares nonsmokers (those whom mothers reported did not smoke) and smokers (those whom mothers reported smoked inside or outside of the

home, or both); mothers without partners were coded as missing data. Maternal alcohol use was based on the item: "How often do you drink alcohol?" Drinking was dichotomized to compare nondrinkers (those reporting never or rarely drinking, or drinking a few times a year) and drinkers (those reporting monthly, weekly, or daily alcohol use).

Family characteristics identified in the literature as related to adolescent substance use were included in the analyses in order to determine whether or not they could account for sibling resemblance in tobacco and alcohol use. Information was based upon maternal reports, and for all variables, higher scores represent an increased risk of substance use.

Maternal education was assessed at the prenatal interview and compares those who did not graduate from high school to all others. All other variables were assessed at the 14-year follow-up. Stressful life events refers to the total number of 11 events experienced, including the death or illness of a friend or family member, unemployment of either parent, family moves, and other trauma. Maternal depression denotes mothers who reported four or more of seven depressive symptoms from the Delusions Symptoms-States Inventory (Bedford & Foulds, 1978), such as having difficulty sleeping, doing "absolutely nothing," perceiving the future as hopeless, and so on. Single-parent status is dichotomized as married or in a de facto relationship, compared to those who were single, widowed, or divorced. Parental violence was measured according to the frequency of seven behaviors (e.g., partners' yelling, throwing objects, pushing, hitting, etc.) (alpha = 0.98) in the past year, as derived from the Conflict Tactics Scale (Straus, 1979). Other dichotomous family characteristics included whether or not either parent had ever been arrested, and low family income (those earning less than $20,800 AUD per year or $400 per week).

STATISTICAL PROCEDURE

Sibling similarity in substance use was first assessed using Pearson correlation coefficients of older and younger siblings' substance use. Chi-square analysis was then utilized to compare the percentages of older and younger siblings, as well as parents and younger siblings, who reported tobacco and alcohol use. Logistic regression analysis was performed to determine whether or not older siblings' use was related to younger siblings' similar behavior, controlling for shared family characteristics, as well as to compare the relative effects of use by siblings and parents.

RESULTS

ASSOCIATIONS BETWEEN OLDER AND YOUNGER SIBLINGS' TOBACCO AND ALCOHOL USE AND PARENTAL AND CHILDREN'S USE

Table 1 details the percentages of older and younger siblings and their parents who reported tobacco and alcohol use. Rates of substance use are very similar between siblings. Approximately 10% of older siblings report smoking, compared to 13 percent of younger siblings, and approximately 36% of each group report drinking. The results also demonstrate that smoking is more common among mothers' partners (38%) than among mothers (29%), and that 42% of mothers report alcohol use.

Table 2 presents Pearson correlation coefficients between siblings' tobacco and alcohol use and between younger siblings' and parents' use. The results indicate a somewhat greater similarity in substance use levels between siblings than between parents and children. As shown, there are moderately strong and significant associations between older and younger siblings' reports of tobacco (0.27) and alcohol (0.28) use. Regarding parental use, paternal smoking shows a significant but weak association with younger siblings' tobacco use (0.12). Maternal smoking is more strongly correlated with children's tobacco use (0.21), as is maternal alcohol use with children's alcohol use (0.18).

Table 1: Percentage of Siblings and Parents Who Report Tobacco and Alcohol Use (N = 376)

Substance Use	Percent	N
Tobacco		
Older sibling	10.2	38
Younger sibling	12.8	48
Mother	29.0	108
Father	38.1	121
Alcohol		
Older sibling	36.5	137
Younger sibling	35.5	133
Mother	42.1	157

Table 2: Pearson's Correlations Between Younger Siblings' Tobacco and Alcohol Use and Older Siblings' and Parents' Use

Family Use	Younger Sibling Use	
	Tobacco	Alcoh
Older sibling		
Tobacco	**0.27**	0.01
Alcohol	**0.14**	**0.28**
Parents		
Maternal tobacco	**0.21**	**0.13**
Paternal tobacco	**0.12**	0.07
Maternal alcohol	0.04	**0.18**

All significant ($p<0.05$, two-tailed test) associations are shown in bold

Chi-square analyses indicating the proportion of each group of respondents who report substance use are shown in Table 3. Tobacco and alcohol use are more likely among younger siblings who have older siblings engaging in these behaviors, compared to those whose siblings abstain. Approximately 10% of younger siblings with nonsmoking older siblings report tobacco use, compared to 40% of those whose older siblings smoke. Likewise, sibling alcohol use doubles alcohol use among younger siblings (from 25% to 53%).

Table 3: Older Sibling Tobacco and Alcohol Use and the Percentage (N) of Younger Siblings Who Report Use

Older Sibling	Younger Sibling	
	Tobacco	Alcohol
No	9.9 (33)	25.3 (60)
Yes	39.5 (15)**	52.6 (72)**

**p<0.05 chi-square analysis

Having parents who use substances also results in greater substance use by younger children, but the relationships are not as strong when compared to the sibling effects. As shown in Table 4, the percentage of younger adolescents who smoke is three times as great among those whose mothers smoke (23%) and twice as great among those whose fathers smoke (16%), compared to those with nonsmoking parents (8% and 8%, respectively). Having a mother who drinks also results in significantly higher alcohol use among children, compared to those whose mothers abstain (46% compared to 28%).

Table 4: Parental Tobacco and Alcohol Use and the Percentage (N) of Younger Siblings Who Report Use

Parental Use	Younger Sibling Use	
	Tobacco	Alcohol
Maternal Tobacco		
No	8.3 (22)	31.7 (84)
Yes	23.4 (25)**	44.9 (48)**
Paternal Tobacco		
No	8.2 (16)	32.7 (64)
Yes	15.7 (19)**	39.7 (48)
Maternal Alcohol		
No	10.5 (25)	28.2 (61)
Yes	16.9 (23)*	45.5 (71)**

*p<0.10 **p<0.05 chi-square analysis

THE RELATIVE CONTRIBUTIONS OF PARENTAL AND SIBLING SUBSTANCE USE TO ADOLESCENT SMOKING AND DRINKING

Logistic regression analyses were next used (1) to determine whether or not the association between siblings' rates of substance use could be attributed to shared family factors and (2) to compare the relative contributions of parental and sibling substance use on adolescent smoking and drinking. Separate regression analyses were conducted for tobacco and alcohol use, and all independent variables were entered into the analyses simultaneously.

Table 5 presents the unstandardized coefficients and odds ratios for the model predicting adolescent tobacco use among younger siblings. The results demonstrate a strong, positive association between sibling tobacco use, with tobacco use by older siblings increasing the odds that younger children will smoke by over four times (an

odds ratio of 4.51). Moreover, tobacco use by older siblings remains a strong and significant predictor of tobacco use by younger siblings controlling for numerous shared family experiences, indicating that the family environment cannot fully account for the similarity in sibling tobacco use.

The findings also demonstrate that maternal smoking significantly increases the odds of tobacco use by younger children. However, the odds ratio (2.90) is less than that of sibling smoking, indicating a somewhat weaker effect of maternal tobacco use. Paternal smoking does not significantly increase the likelihood that younger children will smoke, even when entered into a model excluding the sibling and maternal smoking variables (analyses not shown). The only other family characteristic significantly related to adolescent tobacco use is maternal depression, which more than triples the odds of smoking. It should also be noted that some of the other family variables have relatively strong odds ratios but may fail to reach conventional levels of significance due to the small sample size.

The results for adolescent alcohol use are similar. As shown in Table 6, drinking by older siblings has a moderately strong, positive effect, more than tripling the odds that younger siblings will use alcohol. As before, this relationship remains significant controlling for all other family characteristics. Maternal alcohol use also significantly increases the likelihood that adolescents will drink, but the odds ratio is smaller than that for sibling drinking (odds ratios of 1.87 for maternal use and 3.14 for sibling use). Maternal depression again increases the likelihood of adolescent substance use, more than doubling the odds of drinking, and the relationship between parental violence and adolescent alcohol use approaches significance ($p < 0.10$) in the expected direction.

Table 5: The Relationship Between Older Siblings' and Parents' Tobacco Use and Younger Siblings' Tobacco Use (Logistic Regression)

Variable	B	OR
Sibling tobacco use	1.51	4.51***
Maternal tobacco use	1.07	2.90**
Paternal tobacco use	0.05	1.05
Maternal low education	-0.02	0.99
Maternal stressful life events	0.20	1.22
Maternal depression	1.19	3.29**
Single-parent	0.86	2.36
Parental violence	-0.04	0.96
Parental arrest	0.59	1.81
Family low income	-0.33	0.72
Constant	-3.08	0.05****
N	304	
Chi-square	39.26****	

**p<0.05 ***p<.01 ****p<.001

Table 6: The Relationship Between Older Siblings' and Maternal Alcohol Use and Younger Siblings' Alcohol Use (Logistic Regression)

Variable	B	OR
Sibling alcohol use	1.14	3.14****
Maternal alcohol use	0.63	1.87**
Maternal low education	-0.22	0.81
Maternal stressful life events	0.11	1.12
Maternal depression	0.89	2.45**
Single-parent	0.46	1.58
Parental violence	0.13	1.14
Parental arrest	0.13	1.14
Family low income	-0.29	0.75
Constant	-1.73	0.18**
N	355	
Chi-square	51.43****	

**p<0.05 ***p<.01 ****p<.001

DISCUSSION

These results suggest a moderately strong relationship between siblings' tobacco and alcohol use during adolescence. According to the findings, siblings reported similar levels of substance use at age 14, and there were statistically significant associations for tobacco use (a correlation of 0.27) and alcohol use (0.28). Moreover, older siblings' self-reports of smoking and drinking were positively related to younger siblings' reports in multivariate analyses, with an odds ratio of 4.51 for tobacco use and 3.14 for alcohol use.

While other research has also demonstrated significant associations between siblings' rates of substance use (Boyle et al., 2001; Durrington et al., 2003; Epstein et al., 2002; Miller & VoIk, 2002; O'Connell et al., 1981; Rowe & Gulley, 1992; Unger & Chen, 1999), many prior investigations have not included a broad range of shared family characteristics in their analyses. In the current study, the relationship between siblings' self reported tobacco and alcohol use remained significant, controlling for numerous shared family experiences that might impact upon both siblings to produce similar rates of use. Moreover, the sibling coefficients are larger than any of the other independent variables, further suggesting that the sibling relationship itself, rather than the shared family environment, may best account for sibling resemblance. The influence of maternal depression upon adolescent substance use should not be overlooked, as depression was significantly and positively related to tobacco and alcohol use. In fact, the odds ratio for depression was greater than that of maternal substance use, and it is important that future work continue to explore the contribution of maternal mental health to children's substance use.

It should also be noted that other potential family influences on smoking or drinking, such as parental monitoring, supervision, or communication with children during early adolescence, were not included in the current analysis, and it is possible that their addition may have reduced the strength of the sibling association. This investigation was also unable to control for genetic influences, which could account

for sibling resemblance. Genetic effects are best assessed through adoption or twin studies, and many such investigations have documented greater similarity in antisocial behavior for biological rather than adopted siblings (McGue et al., 1996; Mednick, Gabrielli, & Hutchings, 1987; van den Oord, Boomsma, & Verhulst, 1994; van der VaIk, Verhulst, Neale, & Boomsma, 1998), and monozygotic compared to dizygotic twins (Edelbrock, Rende, & Plomin, 1995; Rowe & Osgood, 1984). More research is needed to determine whether or not these or other family risk factors may account for some similarity in sibling substance use.

It is also important that future research illuminate the specific processes whereby one sibling may directly influence another to engage in tobacco or alcohol use, as such examination was not possible in the current study. Several mechanisms of transmission are possible. It may be that individual risk factors increase the likelihood that older siblings will engage in substance use; then, as predicted by social learning theory, younger siblings imitate the behavior. Siblings may also actively advocate the benefits of substance use or procure substances for their siblings, thereby increasing younger siblings' likelihood of use (Brook et al., 1990). Finally, siblings may engage in smoking or drinking together, and/or share a deviant peer group that promotes substance use (Rowe & Gulley, 1992). Though all of these processes are possible, further investigation is needed to better specify the circumstances under which sibling transmission of substance use occurs.

The current findings strongly suggest that substance use by older siblings has a greater effect on younger siblings' tobacco and alcohol use compared to parental use. Other research has demonstrated similar results (DeWitt et al., 1995; Brook et al., 1990; Epstein et al., 2002; Unger & Chen, 1999), although past work has been limited by reliance on respondent reports of sibling and/or parental use, and by analyses that typically assess sibling and parental effects separately. In contrast, the current investigation is based upon self-reported information regarding substance use from each sibling and from mothers, and the multivariate models simultaneously assess the effects of substance use by each type of family member.

According to the current findings, tobacco and alcohol use by older siblings increased the odds of similar behavior by younger siblings by three to five times, while maternal smoking tripled the odds of smoking by younger children, maternal drinking doubled the odds of alcohol use, and paternal smoking was not significantly related to younger siblings' smoking. This evidence indicates that siblings may act as more powerful role models than parents, particularly during adolescence, as siblings likely share more of their time, activities, and interests than do parents and children. Additional analysis is needed to explore the nature of these sibling influences, however. It may also be helpful to compare the processes whereby siblings and unrelated peers affect adolescent substance use. Detailed comparisons of peers and siblings can indicate the relative contributions of use by these parties, as well as help to clarify the ways in which such influences occur.

Other limitations of this investigation emphasize the need for continued exploration of familial influences on adolescent substance use. First, the data are cross-sectional and cannot identify the temporal sequence whereby transmission of substance use may occur. In addition, although the study was innovative in relying on self-reported information from all parties, each dependent variable was based upon a single item

only, and more comprehensive measures would improve the reliability of the variables. Likewise, the measures of adolescent substance use do not necessarily indicate continued or serious use of tobacco and alcohol and may be more representative of experimental use. This may be particularly true of adolescent drinking, given that some of those classified as alcohol users report rarely drinking, rather than regular use of alcohol. Nonetheless, it is important to note that the measures are assessed when respondents are aged 14, and even occasional use of tobacco or alcohol this early in the life course may be a marker for prolonged substance use or involvement in more serious forms of delinquency.

In fact, the early onset of substance use has been identified as an important risk factor for later serious and violent delinquency (Lipsey & Derzon, 1998; Loeber, 1996; U.S. Department of Health and Human Services, 2001). Given this relationship, the findings have important implications for the prevention of substance use as well as other forms of crime and delinquency. The results underscore the need to include siblings, or at least address issues relating to sibling relationships and influences, in prevention efforts. Currently, most tobacco and alcohol prevention programs target individuals for change or are aimed at improving parent-child communication and interactions. If siblings are more powerful role models than parents, however, siblings and their potential influences on each other should be a primary focus of intervention.

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